

**General Remarks:**

Claims 2, 6-9, 11-12 and 18-20 remain cancelled without prejudice of re-submission or pursuit by way of a continuation application. Applicants note that the prior rejections of claims 1-20 under 35 USC § 112 and of claims 1-16, 8-10, and 13-20 under 35 USC § 102(b) and under 35 USC § 103(a) were withdrawn by the examiner in view of the amendment filed on March 29, 2009.

**Rejections Pursuant to 2<sup>nd</sup> Paragraph of 35 USC § 112:**

Claim 17 stands rejected as being indefinite due to the use of the limitation “the hydrocarbons” in line 3, on the ground that there is insufficient antecedent basis for this limitation. Applicants have amended claim 17 to provide antecedent basis. Applicants have made a similar amendment to claim 1.

**Rejections Pursuant to 35 USC § 103(a):**

Claims 1, 3, 4, 5, 10, 13 and 14-17 stand rejected as being unpatentable over WO 01/56960 (equivalent to Hamper, US 7,002,052) in view of either Ruotto et al. (US 6,045,688) or Gartside et al. (US 5,254,788). Applicants submit that Hamper discloses an integrated process for the preparation of a C<sub>2-5</sub> alkenyl-substituted aromatic compound and hydrogen from a C<sub>2-5</sub> alkane and a C<sub>6-12</sub> aromatic compound by contacting the alkane and the alkenyl substituted aromatic compound in a dehydrogenation reactor in the presence of a dehydrogenation catalyst to prepare a dehydrogenation effluent stream comprising C<sub>2-5</sub> alkenyl-substituted aromatic compound, the C<sub>2-5</sub> alkyl-substituted aromatic compound, a C<sub>2-5</sub> alkene, a C<sub>2-5</sub> alkane, and hydrogen. The Examiner indicates that “Hamper does not disclose the contact times of the catalyst in the dehydrogenation zone and in the separation zone.” (Final Office Action at page 4.) However, applicants respectfully submit that the dehydrogenation reactors described in Hamper are not riser reactors. Rather, Hamper discloses at col. 12, lines 8-12 that in the *fluid bed dehydrogenation* reactor for the preferred dehydrogenation of ethane and ethylbenzene, *the residence time of the catalyst in the fluid-bed typically varies from 5 to 15 minutes, preferably from 10 to 15 minutes.* Thus, the teaching of Hamper is that, for example, where styrene is prepared by the dehydrogenation of ethylbenzene, one of skill in the art would use a traditional fluid bed reactor, with a “slow moving” bed, where the residence time of the catalyst in the bed varies from 5 to 15 minutes. Further, the teaching of Hamper is that a C<sub>2-5</sub> alkane is also present during the reaction.

Ruotto concerns the dehydrogenation of a feed comprising pentanes, isobutane, n-butane [sic-butane], propane or a mixture thereof. (col. lines 45-50.) For the dehydrogenation of these light paraffins, Ruotto proposes a riser reactor configuration in conjunction with a specifically designed

separation apparatus: “Accordingly, the multiport cyclone adapted above the axially onnllar reactor riser gives essential advantages in flow dynamics and process engineering over conventional arrangements and generally used single-port cyclones”. Col. 6 at lines 60-64.

Gartside teaches a dehydrogenation process, again for use with light paraffinic compounds, using a *downer* reactor. As is known to those of skill in the art, a downer reactor configuration is preferred when a particularly sharp separation of products is needed. For example, if a reaction is A to B to C, and one wants to produce more of product B, one would use a downer reactor to avoid the reaction proceeding as much to C.

Applicants submit that there is no motivation to combine the teachings of Hamper and Ruotto or Hamper and Gartside. Hamper, which teaches the co-dehydrogenation of ethane and ethylbenzene, teaches the use of a *slow moving fluid bed configuration with long catalyst residence times*. Nothing in Hamper or Ruotto suggests that where the dehydrogenation of an *alkylaromatic compound* occurs, that a configuration such as the one proposed by Ruotto would be relevant. Ruotto is directed to the dehydrogenation of *light paraffinnic compounds* and specifically teaches that a special type of separation device (e.g., multiport or multi-inlet cyclone) must be used in order to accomplish the reaction in the short time frames taught. In contrast, as is made clear in the specification of the present application, the separation device for the dehydrogenation of an alkylaromatic compound can be a conventional solid-gas impingement separator, such as a cyclone separator, but can also be done by any conventional means for solid-gas separations, such as filtration and liquid suspension. Application at page 7, lines 19-22. Thus, Ruotto teaches away from the present invention, as well as the combination of its teachings with that of Hamper.

Similarly, regarding the proposed combination of Hamper and Gartside, a person of skill in the art might perhaps conclude that it would be desirable to replace the slow moving bed of Hamper might be replaced by the use of a *downer* reactor (not a riser reactor) for the dehydrogenation of *light paraffinnic compounds*.

Applicants have also submitted two new claims. Claim 21 is directed to the contacting occurring in the absence of steam. The benefits of steam in the dehydrogenation of ethylbenzene to styrene are well known, and the prior art clearly teaches away from applicant’s claimed invention. See, for example, Ullmann’s Encyclopedia of Industrial Chemistry, Styrene, 2002, (copy attached) which indicates that the dehydrogenation of ethylbenzene is carried out in the presence of steam, which has a threefold role:

1. It lowers the partial pressure of ethylbenzene, shifting the equilibrium toward styrene and minimizing the loss to thermal cracking
2. It supplies the necessary heat of reaction
3. It cleans the catalyst by reacting with carbon to produce carbon dioxide and hydrogen.

Support for this claim can be found at least in the original claims as filed as well as specification at page 6, lines 8-9 and page 15, lines 31-21.

Support for new Claim 22 can be found in the specification at least at page 6, lines 1-6. Claim 22 additionally distinguishes from Hamper in that it is directed to the dehydrogenation of alkylaromatic hydrocarbons, where the gaseous stream further contains one or more inert diluent gases. In Hamper, the dehydrogenation of ethylbenzene is conducted in the presence of ethane, which is not an inert diluent gas.

Please reconsider the obviousness rejections. In the event the rejection is maintained, the Office is requested to provide an explanation as to why one skilled in the art would modify Hamper with the teachings of Gartside to operate in concurrent upward flow using a riser reactor or why one of skill in the art would modify Hamper with the teachings of Ruotto to operate a riser reactor using a conventional means for solid-gas separations.

Applicants request reconsideration of the outstanding rejections and allowance of the amended claims.

Respectfully submitted,

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